FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6(a) CLOCK

FIG. 6(b) T₁

FIG. 6(c) Ta

FIG. 6(d) TR

FIG. 6(e) Tb

FIG. 6(f) To

FIG. 6(g) ω

FIG. 7

FIG. 8

FIG. 9

FIG. 10

FIG. 11

FIG. 12

FIG. 13

FIG. 14

FIG. 15

42

88

89

89a

FIG. 16

1 2 3 4 5 6 7 8 9 10

Continue ? Yes . No
Last Access: Dec 21.1991.
Name   : HENRY
Last Program: No.6.
Time   : 2`16"01
Preset No: 2.6.9.11

14

15

16

15a

1

FIG. 17

FIG. 18

18

FIG. 19

FIG. 20

FIG. 21

FIG. 22

FIG. 23

FIG. 24

FIG. 25

FIG. 26

FIG. 27

FIG. 28

PLACE DISK ～220

DISCRIMINATE DISK ～221

MOVE HEAD TO TOC TRACK ～222

READ TOC ～223

READ FLAG ～224

OPT RECORDABLE DISK ? ～225

ROM
NO DISK

YES

REPRO INST ? ～226 NO

YES

REPRODUCE AND STORE MAIN SIG ～227

MEMORY IS FULL ? ～228 NO

YES

FLAG=1 ? ～229 NO

YES

REPRO SUB SIG IS COMPLETE ? ～230 YES

NO

REPRODUCE AND STORE SUB SIG ～231

STORE REPRO IS POSSIBLE ? ～232 NO

YES ～233

NO MEMORY IS FULL ?

YES

STORE REPRO IS POSSIBLE ? ～234 NO

YES

TRANSFER SUB SIG TO OPT RECORD REGION ～235

TRANSFER IS COMPLETE ? ～236 YES 237

FLAG=0

NO

201

202

203

REPRO INST ? ～238 204

YES ～239

OPT AND MAG REPRODUCE

ALL OPE ENDS ? ～240 NO

YES

MAG RECORD CHG INFO ～241

EJECT DISK ～242

RECORD INST ? ～243 NO 205

YES ～244

STORE MAIN SIG

245a NO

FREE AREA ? ～245

OPT RECORD

FLAG=1 ? ～246

NO

YES

REPRODUCE AND STORE MAG SIG ～247 206

NO

FREE AREA ? ～248

YES

TRANSFER SUB SIG ～248a

TRANSFER IS COMPLETE ? ～249 YES

NO 250 ～ FLAG=0

REPRODUCE AND STORE SUB SIG ～251 207

TRANSFER SUB SIG ～252

NO

TRANSFER IS COMPLETE ? ～253

YES

FLAG=0 ～254

NO

ALL OPE ENDS ? ～255

YES

WRITE INTO MAG TOC ～256

EJECT DISK ～257

FIG. 29

201

220 PLACE DISK

221 DISCRIMINATE DISK

222 MOVE HEAD TO TOC TRACK

223 READ TOC

224 READ FLAG

225 OPT RECORDABLE DISK ?
NO
YES

226 REPRO INST ?
NO
YES

227 REPRODUCE AND STOR MAIN SIG

202

204

238 REPRO INST ?
YES

239 OPT AND MAG REPRODUCE

240 OPE ENDS ?
NO
YES

241 MAG RECORD CHG INFO

242 EJECT DISK

205

243 RECORD INST ?
NO
YES

260 MAG TRACK IS SAME ?
YES
NO

261 RETRIEVE DATA

262 SAVE

263 OPT RECORD

261a RETRIEVE DATA

206

264 OPE ENDS ?
NO
YES

265 MAG RECORD CHG INFO

266 EJECT DISK

FIG. 30(a)

FIG. 30(b)

FIG. 31

FIG. 32

FIG. 33

FIG. 34

FIG. 35

FIG. 36

FIG. 37

FIG. 38

FIG. 39

FIG. 40

FIG. 41

51

2

67f

67

67g

210

8d

8e

8

8a

8c

8b

FIG. 42

67f
67
67g
2

210a
210b

8d
8e
8h
8
8a
8c
8b

51
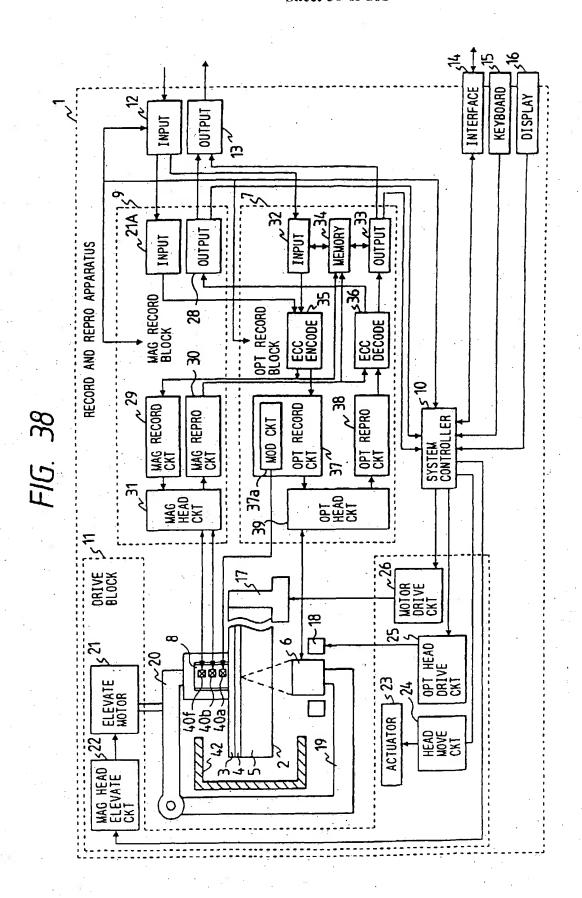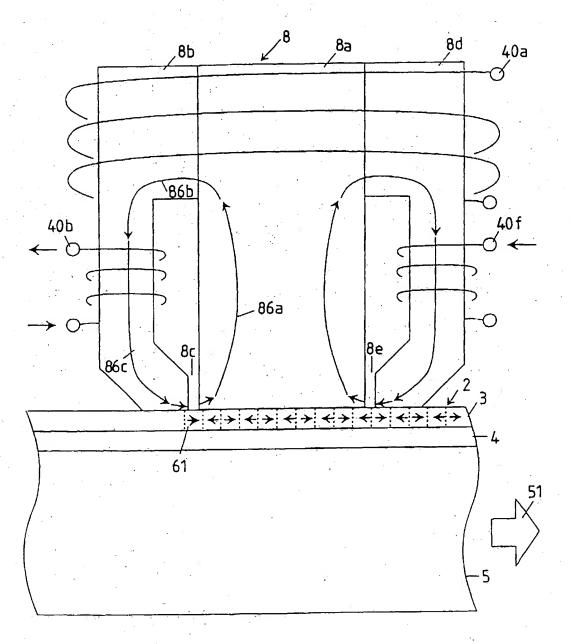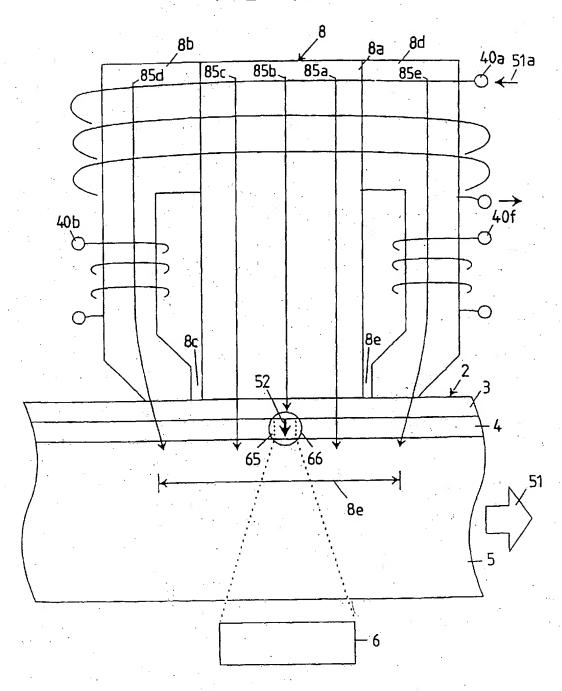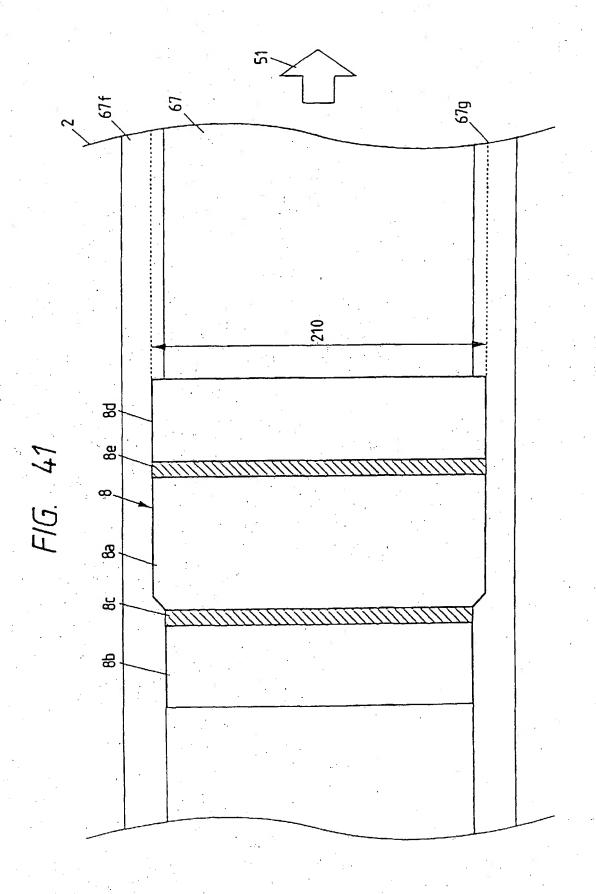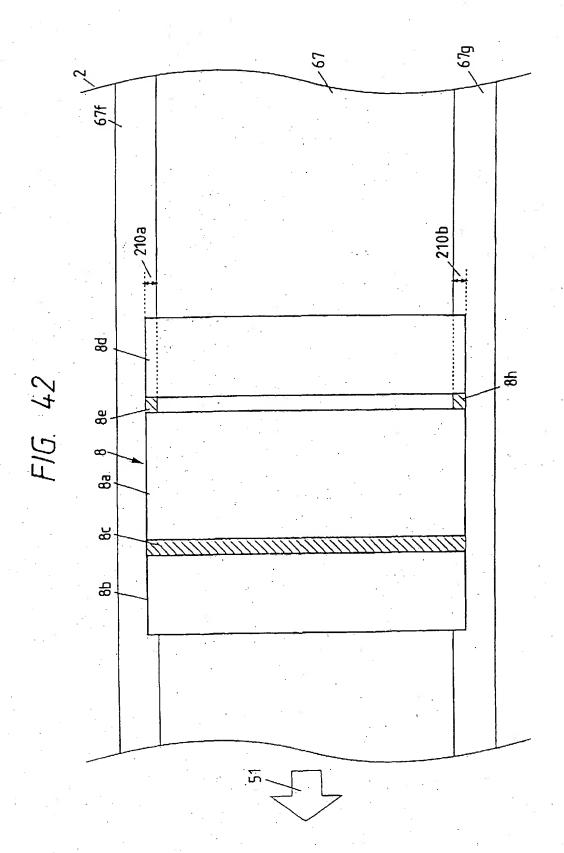
FIG. 43

FIG. 44

FIG. 45(a)

FIG. 45(b)

FIG. 46(a)

FIG. 46(b)

FIG. 47(a)

FIG. 47(b)

FIG. 48(a)

FIG. 48(b)

FIG. 49(a)

FIG. 49(b)

FIG. 49(c)

FIG. 50(a)

42

A --------- A'

FIG. 50(b)

42

307

FIG. 50(c)

305
304

FIG. 50(d)

310
305
42a
304
2

FIG. 51

FIG. 52

FIG. 53(a)

FIG. 53(b)

FIG. 54(a)

8

FIG. 54(b)

8

FIG. 55(a)

FIG. 55(b)

FIG. 56

FIG. 57(a)

FIG. 57(b)

FIG. 58

42

310

2

3

FIG. 59

FIG. 60

FIG. 61

FIG. 62

FIG. 63

310
311
42
305
304
3
2

51a

FIG. 64

FIG. 65

FIG. 66

311

314

42

310

303a

303

3

2

FIG. 67

FIG. 68(a)

FIG. 68(b)

FIG. 69(a)

FIG. 69(b)

FIG. 70(a)

B

316

305a

B'

305

304

306a

FIG. 70(b)

316

304a

305a

FIG. 70(c)

B

307a

307

B'

302

FIG. 71

FIG. 72(a)

FIG. 72(b)

FIG. 73(a)

FIG. 73(b)

FIG. 74(a)

FIG. 74(b)

FIG. 75

FIG. 76

FIG. 77

FIG. 78(a)

FIG. 78(b)

FIG. 79(a)

FIG. 79(b)

FIG. 80(a)

FIG. 80(b)

FIG. 81(a)

FIG. 81(b)

FIG. 81(c)

FIG. 82(a)

FIG. 82(b)

FIG. 83

FIG. 84(a)

FIG. 84(b)

FIG. 85(a)

FIG. 85(b)

FIG. 86

322 323a 324a 324b 324c 324d 324e 324f

| | 001 | 002 | 003 | 004 | 005 | 006 | 007 | 008 | 009 | | 369 | | 001 | 002 | 003 | 004 | 005 |

ADDRESS 1

ADDRESS 2

323b

320a

320b

2

67

FIG. 87

MAG RECORD REPRO CKT

INPUT DATA

ADDRESS

MAG RECORD CKT 334   29

333 MAG RECORD CKT

21A

INPUT CKT

30

SEPARATE CKT

MOD CKT

BUFFER MEMORY

34

A HEAD SIGNAL

B HEAD SIGNAL

MAG REPRO CKT

10

SYSTEM CONTROLLER

335

DISK ANGLE DET

338

24a

TRAVERSE MOVE CKT

339

TABLE

TRAVERSE CONTROLLER

38

OPT REPRO CKT

25

OPT LINE COUNTER

336

OPT HEAD DRIVE CKT

MEMORY

8a

8b

20

2

6

18

17

23a

TRAVERSE ACTUATOR

FIG. 88(a)

8a   8b

FIG. 88(b)

T_H T_{pa}, T_{pb}

FIG. 88(c)

T_{Ha} T_{pa} T_{pb}

T_{Ha}

FIG. 89

FIG. 90

FIG. 91

FIG. 92(a)A

FIG. 92(a)B

FIG. 92(a)S

FIG. 92(b)A

FIG. 92(b)B

FIG. 92(b)S

FIG. 93

FIG. 94(a)

345

Reference pointers: 349a, 349b, 349c, 349d, 349e (pointing to columns at 26, 36, 46 region), Tpo, arrow → 0

345a (A₁)	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
B₁																
345b (A₂)	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
B₂																
345c (A₃)	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
B₃																
345d (A₄)	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
B₄																

FIG. 94(b)

Reference pointers: 350a, 350b, 350c, 350d, 350e, arrow → 5

T₁	11	12			25	26	27	28	29	30	31	32	33		25	26
T₂		22	23	24	25	26							33	34	35	
T₃	21	22			35	36	37	38	39	40	41	42	43	44	45	36
T₄	31	32		34	35	46	47	48	49	50		44		44	45	46
T₅	31	32			45				49	50	51	52	53	54		54

FIG. 94(c)

Reference pointers: 351, 351a, 351b, arrow → 5

A₁	21	22	23	24	25	26	27	28	29	30	31	32	33	34
A₂	31	32	33	34	35	36	37	38	39	40	41	42	43	44
A₃												32	33	34
A₄												42	43	44

FIG. 95

START

n=1

REPRO TRACK PITCH=Tp/n

IS ERROR RATE LARGE ?   NO

YES

n=n+1

IS ERROR RATE LARGE ?   YES

NO

IS ERROR RATE SMALL ?   NO

YES

n=n-1

IS ERROR RATE LARGE ?   NO

YES

FIG. 96

FIG. 97

TRAVERSE GEAR ROTATION NUMBER

$$R = \frac{4 +}{n_0} \; r.p.s$$

RADIUS

320a   360°   320b   360°   320c   360°   320d   360°   320e   320x

n_0

n_0 0

FIG. 98

FIG. 99

FIG. 100

FIG. 101(a)

FIG. 101(b)

FIG. 102

FIG. 103(a)

P = 1

FIG. 103(b)

P = 2

FIG. 103(c)

P = 3

FIG. 103(d)

P = 4

FIG. 103(e)

P = 5

FIG. 103(f)

P = 6

P = 1

FIG. 104(a)

P = 2

FIG. 104(b)

P = 3

FIG. 104(c)

P = 4

FIG. 104(d)

P = 5

FIG. 104(e)

P = 6

FIG. 104(f)

FIG. 105

FIG. 106(a)

FIG. 106(b)

FIG. 106(c)

FIG. 107(a)

P = 1

FIG. 107(b)

P = 2

FIG. 107(c)

P = 3

FIG. 107(b)

P = 4

FIG. 107(e)

P = 5

FIG. 108(a)

FIG. 108(b)

60
69
60a
3
43
50
49
359

FIG. 109

FIG. 110

FIG. 111

OFF

ON-A

ON-B

FIG. 112

FIG. 113

FIG. 114

FIG. 115(a)

8

3
69
4

ON

6

FIG. 115(b)

8

3
4

OFF

6

FIG. 116

f=5kHz

D : DISTANCE BETWEEN OPTICAL PICKUP AND MAGNETIC HEAD

FIG. 117

FIG. 118

23

363

367

2

(6)

6

8

(8)

65b

67b

L_2

$2L_2$

L_2

L_1

$2L_1$

L_1

FIG. 119

FIG. 120

FIG. 121

LOUDSPEAKER MAGNET

DC MOTOR

EXPOSED FERRITE MAGNET

MAGNETIC NECKLACE

0   500   1000 1200   1500   2000

MAGNETIC FIELD INTENSITY (Gauss)

FIG. 122

FIG. 123

65a
65b
65c
65d
67a
67b
67c
67d

369 (SYNC)
454 INDEX (OPTICAL-SUBCODE-MSF)
374 (GAP)
373 (CRC)

2

Tpo

DIRECTION OF
DISK ROTATION

FIG. 124

FIG. 125

REFERENCE TABLE 2   368b

WORD	CODE
THOMPSON	1 1
MACINTOSH	1 0
REKHCINGTON	0 1
GALE	0 0

REFERENCE TABLE 1   368a

WORD	CODE
NEW YORK	1 1
WASHINGTON	1 0
CHICAGO	0 1
SAN FRANCISCO	0 0
LOS ANGELS	001

COMPRESSED 2bit DATA "10"

2bit DATA

COMPRESSION DECOMPRESSION PROGRAM

(ENCODE/DECODE)

ORIGINAL 80bit DATA "WASHINGTON"

(ORIGINAL)

80bit DATA

2bit DATA (COMPRESSED)

MAG BLOCK

8

6

OPT REPRO CIRCUIT

3
4
2

FIG. 126

FIG. 127

START — 410
PLACE DISK — 411
RETURN MAG HEAD — 412
MOVE OPT HEAD TO TOC TRACK — 413
READ TOC READ DEFAULT VALUE — 414
FLAG ? — YES
NO — 415
READ OPT MARK — 416
OPT MARK ? — NO → 8
YES — 418
MAG REC REPRO MODE

401

LOWER MAG HEAD — 419
READ INFO FROM MAG TOC TRACK — 420
LIFT MAG HEAD — 421
ERROR CHECK OK ? — 422 NO
YES — 423
ERROR FLAG
PRESENT ? — 423a YES → 5
NO
CHECK OPT ADRS OF MAG TRACK — 424
OK ? — 425 YES
NO — 426
UPDATE OPT ADRS INFO

402

→ 1

1

MAG READ INST ? — 428 NO → 2
YES
VARIABLE TRACK PITCH MODE ? — 429 NO → 2
YES

403

n=0 — 430
n=n+1 — 431
n=LAST ? — 432 YES
NO
ACCESS TO OPT TRACK GROUP — 433
DEFULT TRACK ? — 434 NO
YES — 435
ACCESS TO NEW OPT ADRS
LOWER MAG HEAD — 436
READ AND STORE MAG DATA — 437
COMPLETE MAG READ — 438
LIFT MAG HEAD — 439

403a

→ 3

2

NORMAL MODE ? — 440 NO → 3
YES
MAG TRACK ACCESS INST — 441
OBTAIN OPT ADRS INFO — 442
ACCESS TO OPT TRACK — 443
READ DATA FROM MAG TRACK — 444
STORE DATA — 445

405

→ 3

FIG. 128

③

405

446 NO
MAG UPDATE INST ?

YES

447 YES
FINAL STORE INST ?

NO

448 YES
DATA IN MEMORY ?

NO

ACCESS TO OPT TRACK — 449

LOWER MAG HEAD — 450

READ MAG DATA — 451

STORE DATA — 452

LIFT MAG HEAD — 453

UPDATE — 454

④

406

455 NO
FINAL STORE INST ?

YES

EXTRACT UPDATE DATA — 456

457 NO
UPDATE ?

YES

ACCESS TO OPT ADRS — 459

LOWER MAG HEAD — 460

RECORD MAG DATA — 470

DATA CHECK — 471

472 YES
ERROR RATE IS LARGE ? — ⑦

NO

473
COMPLETE ?

YES

LIFT MAG HEAD — 474

475 YES
ALL WORK ENDS ?

NO

①   ⑥

458
WORK ENDS ?
YES — ⑥

NO — ①

⑤

427

EJECT DISK — 427a

INDICATE "CLEAN DISK" — 427b

STOP — 427c

⑥

407

LIFT MAG HEAD — 476

CLEAN MAG HEAD — 477

ROTATE CLEANERS — 477a

478 NO
EJECT ?

YES — 479
EJECT DISK

STOP — 480

⑦

408

LIFT MAG HEAD — 481

CLEAN MAG HEAD — 482

483 NO
ERROR RATE OK ? — ⑤

YES

①

⑧

REPRODUCE OPT SIG ONLY — 417

FIG. 129(a)

FIG. 129(b)

FIG. 129(c)

FIG. 130

FIG. 131

FIG. 132(a) Clock (opto)

FIG. 132(b) Clock (Magetic)

FIG. 132(c) Reproduce 1

FIG. 132(d) Reproduce 2

Data1

FIG. 132(e) Reproduce 1

FIG. 132(f) Reproduce 1

FIG. 132(g) Reproduce 2

FIG. 132(h) Data2

FIG. 133

FIG. 134

FIG. 135(a)

FIG. 135(b)

FIG. 135(c)

FIG. 135(d)

FIG. 135(e)

FIG. 136

FIG. 137(a)

8b 8a
    386

396 42
387 3 51a

FIG. 137(b)

42
396
387
3

FIG. 137(c)

8b
  8a 386
      42
      396
387 3 51b

FIG. 138(a)

396
42
8b
8a 386 387 3
51a

FIG. 138(b)

42
396
387 3

FIG. 138(c)

42
396
8b 387
386 387
8a 3
3
51b

FIG. 139(a)

FIG. 139(b)

FIG. 139(c)

FIG. 140

FIG. 141(a)

8b 8a 386

42

396

387

3

51a

FIG. 141(b)

42

396

387

3

FIG. 141(c)

8b 8a 386

396

42

387

3

51b

FIG. 142(a)

8

42

387   3

51a

FIG. 142(b)

42

387   3

8

FIG. 142(c)

8

42

51b

FIG. 143(a)

42

51a

386
PHOTO
SENSOR

8a

3

8b

FIG. 143(b)

42

3

386
PHOTO
SENSOR

8a

8b

FIG. 143(c)

42

51b

387

386
PHOTO
SENSOR

68a

8a

3

8b

FIG. 144(a)

FIG. 144(b)

FIG. 145(a)

TOMORROW

45
2
398
387a

387b
20431200I

DATA "204312001"

FIG. 145(b)

2
398
387a

387b
20431200I

DATA "204312001"

FIG. 145(c)

2
398
387a

20431200I

387b
20431200I

DATA "204312001"

FIG. 146(a)

FIG. 146(b)

FIG. 147

ITEM	DATA
DISK ID NO. (OPT)	"204312001"
DISK ID NO. MG	"205162"
PROGRAM 1	1422
PROGRAM 2	
PROGRAM 3	"AAA"

404

MAG BLOCK 386

PHOTO SENSER 386a 386b

387

401

8

67

3
4
2

6

OPT REPRO CKT

DECODER 406

AUDIO EXPANSION 407

AUDIO SIGNAL

DATA SIGNAL

FIG. 148

COMMAND OF STARTING PROGRAM NO. N — 405

↓

ERASE DATA FROM MAG TRACK AND THEN READ KEY INFORMATION — 405a

↓

KEY INFO ? — 405b

NO →

INDICATE KEY INPUT COMMAND — 405c

↓

INPUT KEY NO. — 405d

↓

CORRECT ? — 405e

NO → INDICATE "COPY DISK" — 405f

YES ↓

RECORD KEY DATA — 405g

KEY INFO ? YES ↓ — 405h

READ KEY DATA

↓

READ DISK ID(OPT) — 405i

↓

READ DISK ID(MAG) — 405j

↓

CORRECT ? — 405k

NO → INDICATE "COPY DISK" — 405m

YES ↓ — 405n

SECRET CODE CALCULATION

↓

OK ? — 405p

NO → INDICATE ERROR — 405q

YES ↓ — 405s

START TO USE PROGRAM NO. N

FIG. 149

ITEM	DATA				
DISK ID NO. (OPT)	"20431200 l : N₁ =5 N₂ =3"				
DISK ID NO. (MG)	"20516 2: N₁ =5 N₂ =3"				
PROGRAM 1	n=1	n=2	n=3	n=4	n=5
	XXXX11	XXXX23			
PROGRAM 2	n=1	n=2	n=3		
PROGRAM 3	Program 3				

MAGNETIC RECORD/ REPRO BLOCK 30

OPT SENSOR 386

386a   386b   387

401

8

3 4

2

67

6

OPT REPRO CKT

KEY DECODER 406
SECRET CODE DECODER
KEY DECODER

SYSTEM CONTROL 10

INTERFACE 14

404

1

XXXX23   PC 408a
HDD 409a

XXXX23   PC 408
HDD 409

FIG. 150

```
┌──────────────────────────────────────────┐
│ COMMAND OF INSTALLING PROGRAM NO. N       │ ⟩ 410a
└──────────────────────────────────────────┘
                   │
                   ▼
┌──────────────────────────────────────────┐
│             READ MACHINE ID               │ ⟩ 410b
└──────────────────────────────────────────┘
                   │
                   ▼
┌──────────────────────────────────────────┐
│        CHECK INSTALL READ MAG DATA        │ ⟩ 410c
└──────────────────────────────────────────┘
                   │
                   ▼
┌──────────────────────────────────────────┐
│              MAKE KEY TABLE               │ ⟩ 410d
└──────────────────────────────────────────┘
                   │
                   ▼
┌──────────────────────────────────────────┐
│             READ MACHINE ID               │ ⟩ 410e
└──────────────────────────────────────────┘
                   │
                   ▼
```

410f — ID IS PRESENT ? — YES

NO
410g — FREE AREA IS PRESENT ? — NO

YES

```
┌──────────────────────────────────────────┐
│           ADD ID TO KEY TABLE             │ ⟩ 410h
└──────────────────────────────────────────┘
                   │
                   ▼
┌──────────────────────────────────────────┐
│         RECORD ID INTO MAG TRACK          │ ⟩ 410i
└──────────────────────────────────────────┘
```

410q
┌──────────┐
│ START   │
│ INSTALL │
└──────────┘

410j
┌──────────┐
│ START   │
│ INSTALL │
└──────────┘

410n
┌──────────┐
│ SUSPEND │
│ INSTALL │
└──────────┘

410k — INSTALL SUCCEEDS ? — YES

NO

```
┌──────────────────────────────────────────┐
│        DELETE ID FROM MAG TRACK           │ ⟩ 410m
└──────────────────────────────────────────┘
```

410p
(STOP)

FIG. 151

PERSONAL COMPUTER — 408

411

APPLICATION PROGRAM — 412

SHELL — 413

413

OS (MSDOS.SYS) — 415

416

I/O SYS — 417

DRIVE A — 418a   DRIVE B — 418b   DRIVE C — 418c   DRIVE D — 418d

NETWORK OS — 431

BIOS

CPU — 429   NET BIOS — 435

419   420

INTERFACE (SCSI)

MEMO — 430   COMM PORT — 432

INTERFACE — 14   1a

420   SYSTEM CONTROLLER — 10   DRIVE MEMO — 34a   433

FILE   DATA COMP /EXP   FILE — 422   BACK-UP

435

REPRO — 7   MAG PORTION — 9

2a   4
3

I/F — 409 / 423   I/F — 426

I/F — 424   I/F

427

425

HDD   428

408a

420a   I/F

PERSONAL COMPUTER

HDD

FIG. 152

PHYSICAL ADDRESS	LOGIC ADDRESS	DATA
TOC		
0023	00140	
0125	00650	
0245	01250	

440

421

OPT FILE

PHYSICAL ADDRESS	LOGIC ADDRESS	DATA
00		02, 04, 05
01		
02		
03		
04		
05		
06		

OPT ADDRESS
0023
0125
0245

441
442

422

MAG FILE

00		TOC 01=0023 02=0125······

FIG. 153

408

PERSONAL COMPUTER 411

APPLICATION PROGRAM 412

SHELL 413

413

OS (MSDOS.SYS) 415

431

I/O SYS 416

417

DRIVE A 418a   DRIVE C 418c   DRIVE D 418d

NETWORK OS

BIOS 419

CPU 429

NET BIOS 435

INTERFACE (SCSI) 420   430   MEMO

COMM PORT 432

INTERFACE 14   409   423   426

425   FILE 7   I/F 424   I/F

34a   433   427

FILE 422   BACKUP   1a   425   428

TABLE 443   435   DATA COMP/EXP   HDD

10   9   408a

SYSTEM CONTROLLER   MAG PORTION   420a   I/F

4   PERSONAL COMPUTER

2a   3   HDD

FIG. 154(a)

OPT ADDRESS TABLE — 440

PHYSICAL ADDRESS	LOGIC ADDRESS	DATA
TOC		
A=0023	0140	
B=0125	0250	
C=0125	0650	
D=0150	0850	
E=0180	0950	
F=0256	0999	

421

OPT FILE

422

422

MAG ADDRESS TABLE — 441

PHYSICAL ADDRESS	LOGIC ADDRESS	DATA	OPT ADDRESS
00	φ1000		TOC
a=01	φ1001		(0023)
b=02	φ1002		(0046)
c=03	φ1003		(0125)
d=04	φ1004		(0150)
e=05	φ1005		(0180)
f=06	φ1006		(0256)

442

00		

03=0125, 04=0150, 05=0180

FIG. 154(b)

443

TABLE

443

MAG ADDRESS TABLE		OPT DATA	
PHYSICAL ADDRESS	LOGIC ADDRESS	PHYSICAL ADDRESS	LOGIC ADDRESS
a=01	1001	A=0023	0140
b=02	1002	B=0046	0250
c=03	1003	C=0125	0650
d=04	1004	D=0150	0850
e=05	1005	E=0180	0950
f=06	1006	F=0256	0999
......	......	......	......

FIG. 155

FIG. 156

START PROGRAM — 444

m=0 — 444a

m=m+1 — 444b

m ENDS ? — 444c — YES

NO

REPRODUCE OPT DATA — 444d

SUBROUTINE — 444e

n=0 — 444f

n=n+1 — 444g

n ENDS ? — 444w — YES

NO

READ OPT ADDRESS — 444h

$M(n)-10 < A(m) < M(n)+10$? — 444i

NO

YES

CONTROL MAG HEAD REPRODUCE MAG DATA FIX TRAVERSE — 444j

REPRO ENDS ? — 444k

NO

YES

REPRODUCTION END — 444m

ENDS ? — 444n — YES

NO

SUBROUTINE — 444p

n=0 — 444q

n=n+1 — 444r

n ENDS ? — 444s — YES

NO

ACCESS TO OPT ADDRESS — 444t

REPRODUCE MAG DATA — 444u

END — 444v

FIG. 157(a)

445
BUG CORRECTING PROGRAM

445a
TRANSFER FILE TO MEMORY

445b
N=0

445c
N=N+1

445d
READ DATA

445e
A=000 ? — NO

YES 445f
CORRECT OPT FILE DATA

445g
A=001 ? — NO

YES 445h
DELETE LINE

445j
CHANGE ADDRESS

445k
A=10 ? — NO

YES 445m
ADD LINE

445n
CHANGE ADDRESS

445p
A=011 ? — NO

YES 445q
PROCESS

445r
N=M ? — NO

YES 445s
OUTPUT FILE

FIG. 157(b)

OPT ADDRESS	DATA

CORRECTING PROGRAM

ROM DATA

421

OPT FILE

422

~446

DATA IN MAG FILE			
MAG ADRS	CORRECTION CONTENTS	OPT ADRS	CORRECTION DATA
001	111	0000	
002	000	01204	GO TO 01256
003	000	01424	GO TO 01457
004	001	01567	
005	001	01568	
006	010	02727	GO TO 02756
007	010	02737	GO TO 02618
008	011	03527	
009	011	05627	

M_4

FIG. 157(c)

421

OPT FILE

422

CORRECTING PROGRAM 447

MEMORY 34

FILE

FILE 448

FIG. 158(a)

```
        ( CORRECTING PROGRAM )  ⟩ 447

                  ↓

        [ READ OPT DATA ]  ⟩ 447a

                  ↓

        [ N=START NUMBER ]  ⟩ 447b

                  ↓

        [ N=N+1 ]  ⟩ 447c

                  ↓

        [ READ DATA ]  ⟩ 447d

                  ↓
                          447e        NO
        < N=K1∼KM ? >

                  ↓ YES
                                447f
        [ CORRECT DATA ]

                  ↓
                          447g   NO
        < END ? >

                  ↓ YES
                          447h
        [ OUTPUT DATA ]
```

FIG. 158(b)

422
MAG FILE

446
CORRECTING TABLE

OPT ADDRESS	CORRECTED DATA
K_1	$X=0$, $Y=2$
K_2	
K_3	
K_4	
K_5	
K_M	

M

FIG. 158(c)

447
421
OPT FILE
422
MAG FILE

CORRECT PROGRAM

448
DATA

FIG. 159

FIG. 160

FIG. 161

FIG. 162

FIG. 163

MAIN COMPUTER ← 408 → | SUB COMPUTER ← 408a →

ROUTINE — 490a

FILE NAME INPUT SAVING COMMAND — 491a

FREE AREA ? — 491b → NO → STOP — 491c

YES

ALL CAN BE RECORDED ? — 491v → YES → VIRTUAL FILE ? — 491w

YES

NO → ROUTINE — 490

READ ID — 491d → RECORD ALL FILES — 491w → NO

ID IS GOOD ? — 491e → NO → CHANGE DEFAULT — 491f

YES

ID SAME ? — 491g → NO

YES — 491h

492i

PRESENT ? — 491i → NO → REPLACEABLE ? → NO

YES — 491k

FREE AREA ? → NO → DISK INSERTION → YES

YES

RECORD DATA — 491m

END ? — 491n → NO

YES

REWRITE — 491p

RECORD CHARACTERISTIC — 491q

RECORD ID, SECRET NO. TIME — 491r

RECORD INTO VIRTUAL DIRECTORY ENTRY — 491s

END — 491t

ERROR — 491u

488

READ ADDRESS — 492a

CONNECTING PROGRAM — 492b

CONNECT ? — 492c → NO → ERROR — 492d

YES

TRANSMIT NEW FILE MAKING COMMAND — 492k

RECEIVE ERROR MESSAGE — 492h

ERROR MESSAGE ? — 493 → YES → ERROR — 492j

NO

NEW FILE REGISTRATION — 492e

ROUTINE

493 — NEW FILE ? — 492f → NO

YES

TRANSMIT DATA — 492m

TRANSMIT ERROR MESSAGE — 492g

FIG. 164(a)

495

A:>Dir   496g
Report VD VSW   10000000 91-08-01 1:01   496a
 PICTURE VD VXX   10000000 92-01-13 6:13   496b
 MOVIE VD   VYY 1000000000 92-01-01 2:16   496c
 CDROM   ZZZ 540000000 92-01-01 3:00   496d

                                495e
                                495f
A:>

FIG. 164(b)

We have ....

FIG. 164(c)

I had ....

FIG. 164(d)

A:>Dir
REPORT VD VSW 2000000 92-06-01 2:04

FIG. 165

```
A:>Dir                                               ⌐ 495
    CDROM1                  <DIR> 89-01-01  3:00
    CDROM2                  <DIR> 89-01-01  3:00      ⌐ 496h
    CDROM   ZZZ 500,000,000 90-01-01  3:00
                  1 FILE
                  0 BYTE USABLE
A:> B:
B:¥>CD VD1
B:¥VD1>Dir                                            ⌐ 496i
    X.V       VSW 10,000,000 91-08-01  1:01
    PICTURE.V VXX 10,000,000 92-01-13  6:13
    MOVIE.V   VYY 10,000,000 92-01-01  2:10
    TEST                  <DIR> 92-01-10  2:15
                  3 FILES              ⌐ 496j
                  8,980,000,000 BYTE USABLE
```

FIG. 166(a)

```
REGISTRATION?
 File "X"
A:>Yes            496p
Password?
A:>123456     496q
OK
```

FIG. 166(b)

```
DRIVE NOT READY
POWER ON DRIVE

        496r
```

FIG. 166(c)

```
ERROR      496s
```

FIG. 166(d)

```
                    496t
INSERT DISK XX
```

FIG. 167(a)

495a

```
D:>Dir
    XXXXA        XXX        100,000 89-02-01  1:01
    XXXXB        XXX        100,000 89-03-01  1:01
    XXXXC        XXX        200,000 89-04-01  1:01

        3 FILES
        2,000,000,000 BYTE USABLE
```
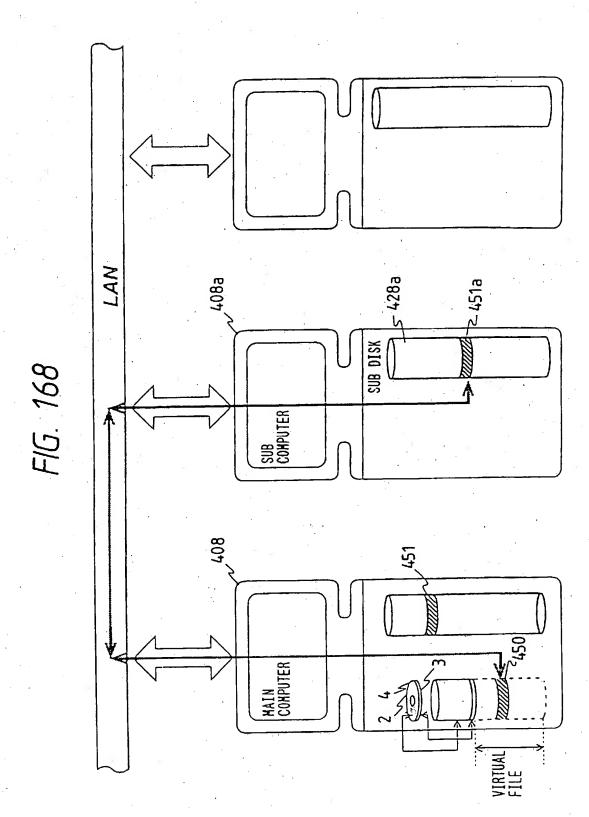
FIG. 167(b)

```
D:>Dir
    XXXXA        XXX        100,000 89-02-01  1:01
    XXXXB        XXX        100,000 89-03-01  1:01
    XXXXC        XXX        200,000 89-04-01  1:01
          VD <Dir >  1,000,000 89-05-01  1:01

        3 FILES
        2,000,000,000 BYTE USABLE
```

FIG. 168

LAN

408a

SUB COMPUTER

SUB DISK

428a

451a

408

MAIN COMPUTER

451

450

2 4 3

VIRTUAL FILE

FIG. 169

```
A:>save file X
Please input your ID?
A:>TOM
MAIN MACHINE ID, SUB DISK ID, DEFAULT VALUES OK?
A:>Yes
Please insert disk XX
A:>
```

FIG. 170
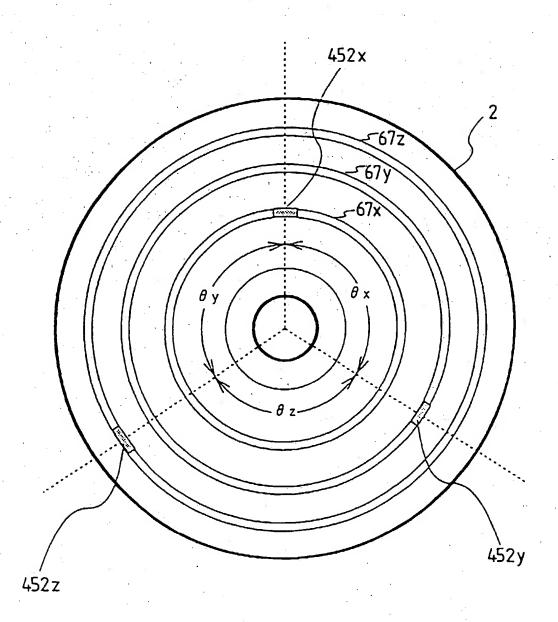
```
A:> Start Program No.11
Please input Password of Program No.N
A:> 123456
OK
```
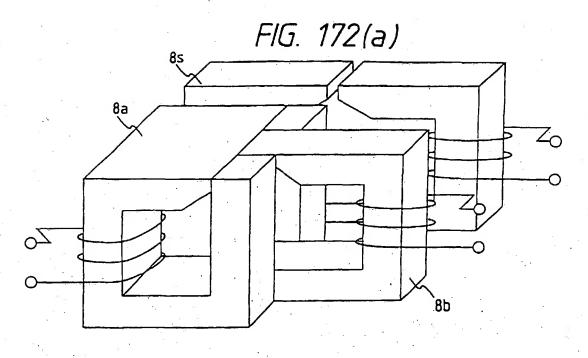
FIG. 171

452x

2

67z

67y

67x

θy

θx

θz

452y

452z

FIG. 172(a)

8s

8a

8b

FIG. 172(b)

2

do

8a

8s

8s

Ls

FIG. 172(c)

8a

41a

41

da

ℓ_1

ℓ_2

FIG. 173(a)

FIG. 173(b)

FIG. 174(a)

8s

8a

8b

FIG. 174(b)

3

do

8a

8s

FIG. 175(a)

FIG. 175(b)

FIG. 176(a)

FIG. 176(b)

FIG. 177(a)

8a

8b

499a

499b

FIG. 177(b)

3

499a

499b

8a

8b

500a

500b

MIX

500c

FIG. 178 (a)

499d

499b

499c

499a

FIG. 178 (b)

499s

500a

500b

MIX

500c

378d

MIX

499b

499c

499d

MIX

500d

500e

FIG. 179

FIG. 180

FIG. 181

FIG. 182(b)
CLOSE

FIG. 182(a)
OPEN

FIG. 183 (a)

FIG. 183(b)

FIG. 183(c)

FIG. 183(d)

FIG. 183(e)

FIG. 184(c)

SUBCODE
504
TOC DATA
MEDIUM IDENTIFIER
AUDIO
SUBCODE

TOC
FIRST TRACK
SECOND TRACK

FIG. 184(b)

504
SUBCODE
AUDIO
MEDIUM IDENTIFIER

TOC
FIRST TRACK
SECOND TRACK

FIG. 184(a)

504
MEDIUM IDENTIFIER

TOC
FIRST TRACK
SECOND TRACK

TOM

507b
508a
67a
507a
508
507

67a
401
505
506
402
403
50

402a

FIG. 185(a)

FIG. 185(b)
FIG. 185(c)
FIG. 185(d)
FIG. 185(e)

FIG. 186(a)

FIG. 186(b)

FIG. 186(c)

FIG. 186(d)

FIG. 186(e)

FIG. 187(a)

FIG. 187(b)
FIG. 187(c)
FIG. 187(d)
FIG. 187(e)

FIG. 188(a)

FIG. 188(b)

FIG. 188(c)

FIG. 188(d)

FIG. 188(e)

FIG. 188(f)

FIG. 189(a)

FIG. 189(b)

FIG. 189(c)

FIG. 189(d)

$r - \Delta r - T_{WH}/2 > r + \Delta r + T_{WH}/2 - T_P$

$T_P > 2\Delta r + T_{WH}$

$(CD : \Delta r = 0.2mm)$

$\underline{T_P > 0.4mm}$

FIG. 190

FIG. 191(a)

FIG. 191(b)

FIG. 191(c)

FIG. 191(d)

FIG. 191(e)

389

Close

51

67a

512

8

51d

51e

393

FIG. 192(a)

67a

512

8

393

FIG. 192(b)

FIG. 192(c)

FIG. 192(d)

FIG. 192(e)

FIG. 193(b)

CLOSE

FIG. 193(a)

OPEN

Close

FIG. 194(a)

FIG. 194(b)

FIG. 194(c)

FIG. 194(d)

FIG. 194(e)

FIG. 195(a)

FIG. 195(b)

PRESENCE OF MAGNETIC HEAD

ABSENCE OF MAGNETIC HEAD

MAGNETIC FIELD INTENSITY (GAUSS)

DISTANCE : L

FIG. 196(a)

FIG. 196(b)

FIG. 196(c)

FIG. 197

FIG. 198(a)

FIG. 198(b)

FIG. 198(c)

FIG. 198(d)

FIG. 199(b)

65d
65c
65b
65a

FIG. 199(a)

2

FIG. 199(c)

67a
4
2
67c 67b
65a

FIG. 200

FIG. 201(a)

FIG. 201(b)

FIG. 201(c)

FIG. 201(d)

FIG. 202

FIG. 203(a)

FIG. 203(b)

DATA | SETUP | SEGMENT

TIME BASE : 0.2µs
SAMPLES : 10⁶
SCAN POS : 10.0µs
CURSOR T : 59.0µs
CURSOR Δ : 11.6µs

ANALYSIS : BY CURSOR
AVERAGING : OFF

ACT

SUM : 173400
MEAN : 64.77962µs
STD DEV : 1.63938µs

MFM
500BPL
HEAD GAP = 30 MICRON
SPACE LOSS = 9 MICRON
WAVE LENGTH = 50 MICRON
HC = 1900 OE

FIG. 204

FIG. 205

DISPERSION LENGTH. : L

FIG. 206

ERROR
RATE

OPTIMAL ERROR CORRECTION
CODE AMOUNT

REDUNDANCY

ERROR CORRECTION CODE AMOUNT RELATIVE
TO ORIGINAL DATA

FIG. 207(a)

	1	2	3	4	5	6	7
	DATA						PARITY
1	A1	A2	A3	A4	A5	A6	A7
2	B1	B2	B3	B4			
3	C1						
4	D1						
5	E1						
6	F1						
7	G1						

452
51a
51aa
51ab
51b

FIG. 207(b)

A1	B1	C1	D1	E1	F1	G1	A2	B2	C2	D2	

DISPERSION LENGTH : L

t

FIG. 208

FIG. 209(a)

35a

ERROR CORRECTION

CALCULATION
GF(2ⁿ)

INPUT DATA

OUTPUT DATA

PARITY

FIG. 209(b)

36a

ERROR CORRECTION

CALCULATOR

OUTPUT DATA

INPUT DATA

PARITY

FIG. 210

PROGRAM

452q

ROUTINE — 452a

DEINTERLEAVING — 452r

PARITY AND DATA — 452b

CALCULATE SYNDROMES S_1, S_2 — 452c

$S_1 = S_2 = 0$? — 452d — YES

NO

CALCULATION FOR ERROR CORRECTION

452e

ERROR CORRECTION ? — 452f — NO

YES

DATA OUTPUT END — 452g

452p

ROUTINE — 452h

MOTOR CONTROL — 452j

ACTUATOR CONTROL — 452k

DRIVE CONTROL — 452m

CONTROL ENDS ? — 452n — NO

YES

FIG. 211

FIG. 212(a)

	1	2	3	4	5	6	7
			DATA				C2 PARITY
1	A1	A2	A3	A4	A5	A6	
2	B1	B2	B3	B4			
3	C1						
4	D1						
5	E1						
6	F1						
C1 PARITY	PARITY	PARITY	PARITY	PARITY	PARITY	PARITY	PARITY

454
51a
51b
453

FIG. 212(b)

A1	B1	C1	D1	E1	F1	C1 PARITY	A2	B2	C2	D2	

DISPERSION LENGTH : L1

t

FIG. 213

FIG. 214

MAG TRACK NO.	INDEX SUBCODE MIN	SEC	FRAME	INDEX PHYSICAL FRAME	SECTOR NUMBER	DENSITY	CAPACITY BYTE	Hc(Oe)	RECORD INHIBIT	BLOCK NUMBER	PHYSICAL FRAME	RATIO	NEW INDEX SUBCODE MIN	SEC	FRAME	NEW INDEX PHYSICAL FRAME
0					1	DD	1024	2900	1							
1	3	15	55	21	1	DD	1024	1900	0	10	15	1/100	3	15	56	21
2	6	20	25					1900	0							
3								1900	0							
4								1900	0							
5								1900	0							
6								1900	0							
7								1900	0							
8								1900	0							
9								1900	0							
10							2048	1900	0							

OPT RECORD PORTION — MAG RECORD PORTION
FORMAT INFORMATION — OPT FRAME INFORMATION

FIG. 215

MAG RECORD DATA

SUBCODE

SYSTEM CLOCK

9

MAG RECORD CKT.

35 — ERROR CORRECT ENCODER

9b — DATA BUFFER

457 — INDEX DET

334 — MOD

WRITE CLOCK

8

456

CONTROL CKT

SUBCODE SYNC DET

CRCC

SUBCODE RAM

CONTROL SIG OUTPUT

SUBCODE DECODER

OPT REPRO SIGNAL

FIG. 216

FIG. 217

DATA INPUT

MAG RECORD CKT

ERROR CORRECT ENCODER

MOD

DATA OUTPUT

~36

ERROR CORRECT DECODER

MAG RECORD CKT

~30b

DEMOD

~459

SYNC DET

PLL

459a

~467

WAVE SHAPER

CLOCK

~466

458 FREQ DIV

CLOCK

OPT REPRO CKT

461 SYNC SIGNAL

460 PULSE DET

463 SYNC DET

B→A

C→0

PREAMP

~261a

7.35kHz/ 14.7kHz/ 29.4kHz

462 SYNC SIGNAL

FREQ DIV/MULTI ~464

A
B
C O
D O

~465

MOTOR CONTROL

f-v

PHASE COMPA

40

ROTATION CONTROL

26

8

2

6

17

FIG. 218(a)

7.35KHz
(14.7KHz)
(29.4KHz)

FIG. 218(b)

FIG. 218(c)

FIG. 218(d)

FIG. 218(e)

FIG. 218(f)

FIG. 218(g)

FIG. 218(h)

FIG. 219

IDEAL TRACK

ACTUAL TRACK

DISK HOLE CENTER

TRACK CENTER

δ

ECCENTRICITY δ (μm)

GAIN [dB]

FREQUENCY [Hz]

DISK SPECIFICATION

ITEM	SPEC
MAX ECCENTRICITY [μm]	±50
MAX ECCENTRIC ACCEL [m/5²]	0.4

FIG. 220

FIG. 221

FIG. 222(a)

FIG. 222(b)

FIG. 222(c)

FIG. 222(d)

FIG. 222(e)

FIG. 222(f)

FIG. 223(c)

FIG. 223 (a)

FIG. 223 (b)

HB IDENTIFIER

EFM SIGNAL 470a

DATA SEQUENCE 470b

Sub code 470c

Q bit 470d

Control bit Q1~Q4 4bit 470e

TOC Area

TOC POINT 8 b i t 470f

"B0"

"0011"

468 a

FIG. 224

FIG. 225

FIG. 226

FIG. 227

Monitor — 449

SP — 449a

Key-pad — 450

1

9

Mag record — 522

Menu select no. table for playback control

21 Mag record

Input — 28

Output

Mag Record CKT — 29

Mag Repro CKT — 30

33

Output unit

Moving picture repro unit — 33b

NTSC/PAL encoder — 33g

D-A video converter — 33f

Synchronous signal generator CKT — 33h

RAM — 33d

MPEG video decoder — 33e

D-A audio converter — 33k

MPEG audio decoder — 33j

RAM — 33m

Sound reprod unit — 33a

Inter-face — 14

Optical repro. CKT. — 38

CD-ROM signal processing

RAM

DMA controller address decoder

21

67a

8

6

2

17

CD signal processing

Drive unit

CPU

RAM — 34

10

FIG. 228

Optical Record Data

Disk Information		Track 1
List ID (Address) Offset Table	525	
Playback Control	523	
Segment Play		
Moving picture 1		Track 2
Moving picture 2		Track 3
Moving picture 3		Track 4
Static picture string 1		Track 5
Static picture string 2		Track 6

Track layout

Moving picture address — 525a
Static picture address — 525b
Play List (Moving picture repro.) — 523a
Selection List (Menu Repro.) — 523b

| Menu Static Picture 1 |
| Menu Static Picture 2 |
| Static Picture 3 |
| Moving Picture 4 |

Magnetic Record data — 522

Menu Screen No. and Select No.Table

Menu Static Picture No.	Select No.1	Select No.2
Name	Name 1	Name2
Menu Static Picture No.1	Select No.1-1	Select No.1-2
Menu Static Picture No.N	Select No.N-1	Select No.N-2

Video CD Format (CD-ROM XA Standard) (ISO9660)

Primary Volume Descriptor (ISO 9660)

Read - In	526
PVD	2.16 sec
Karaoke Information	3.00 sec
Video CD Information	
Segment Play	4.00 sec
Track 2	
Track 3	
Track 4	
Track N	
Read - out	

Moving picture

Track 1

Track 2 - N

(Video CD Data Track)

FIG. 229

Screen display example ~ 524u

Play Start ~ 524t

"Moving picture 1" reproduced

"Still picture string 1" reproduced. (Slide show with sound)

"Menu static picture 1" displayed

(1) Moving Picture 2
(2) Menu

(2) is selected

"Menu Still picture 2" reproduced

(1) Static picture • CD
(2) Slide show
(3) Moving picture 4 and 5

(3) is selected

"Moving picture 4" reproduced

"Moving picture 3" reproduced

End? ~ 524v

No

Yes

Save? ~ 524w

Yes ~ 524x

No

Modify data? ~ 524x

Yes

No

End ~ 524z

Select No. of each Menu magnetically recorded in the magnetic record layer ~ 524y

(1) is selected

"Moving picture 2" reproduced

(1) is selected

"Still picture string 2" reproduced

(2) is selected

Continued to slide show

"Still picture 3" displayed

Video CD Repro. Start ~ 524a

Is there magnetic data? ~ 524b

No

Yes

Magnetic Data Menu Displayed. Operator Name asked ~ 524c

Use magnetic data? ~ 524d

No

Yes

Magnetic data reproduced and data of operator's Menu static picture No. Select No. Table 522 reproduced ~ 524e

According to branching procedure of play sequence descriptor in playback control area, operation to reproduce moving picture with play List and Menu with Selection List is started ~ 524f

Moving picture reproduced according to Play List ~ 524g

Menu static picture data reproduced according to Selection List ~ 524h

Menu static picture No. Select No. Table 522 read ~ 524j

Select No. recorded? ~ 524k

No

Menu screen displayed ~ 524m

Operator's Input ~ 524n

Yes

Select No. Auto select ~ 524p

Screen play ~ 524q

Complete? ~ 524r

No

Yes ~ 524s

Continue?

Yes

No

FIG. 230

Menu Screen No. - Select No. Table

Menu Screen No.	Operator 1	Operator 2	Operator 3	Operator 4
	Name 1	Name 2	Name 3	Name 4
Menu Screen No.1	Select No.1-1	Select No.1-2	Select No.1-3	Select No.1-4
Menu Screen No.2	Select No.2-1	Select No.2-2	Select No.2-3	Select No.2-4
Menu Screen No.3	Select No.3-1	Select No.3-2	Select No.3-3	Select No.3-4
Menu Still Screen No. N	Select No.N-1	Select No.N-2	Select No.N-3	Select No.N-4

522

522n

MPEG Video

	1 pack (2324 bytes)	

| Pack header | | | | | Packet header | | | | | Video data |

Pack Start	SCR	MUX Rate	Packet Start	ID	Packet length	STD buffer (only head packet)	PTS	DTS		Video data
4	5	3	3	1	2	2	5	5		2294 (Head packet is 2294)

MPEG Audio

STD buffer	PTS		Audio data	Zero
2	5		2279	20

PTS : presentation time stamp
DTS : decoding time stamp
SCR : system clock reference
STD : system target decoder

FIG. 231 (a)

FIG. 231 (b)

Sector

150 | 00 | 15 | Index Number 01-99 | Index Number N | 1 track | 15

Front margin

MPEG data

Rear margin

N + 1 ← 00 ←

FIG. 232

Frame	T		Magnetic address
1	1		
2	1		
3	1		
4	1		
----	----		
n	1		

Frame	P		Optical address
1	1		
2	1		
3	1		
4	1		
----	----		
n	1		

FIG. 233

FIG. 234

FIG. 235 (a)

Longitudinal Velocity

1.4

1.3

1.2

t

FIG. 235 (b)

Longitudinal Velocity :
1.2m/s

2a

65a

S

539a

A1

65 : Optical track

FIG. 235 (c)

Longitudinal Velocity :
1.2m/s→1.4m/s

2b

65b

In case of 2 revolutions,
$\theta = 90°$

θ

30°

45°

S

539b

A1

A1

539c

FIG. 236 (a)

Legitimate CD

FIG. 236 (b)

Illegally copied CD

Physical position table

Zone	Address
Z_1	A_8
Z_2	A_6
Z_3	A_4
Z_4	A_{10}

Physical position table

Zone	Address
Z_1	
Z_2	A_6
Z_3	A_4, A_{10}
Z_4	A_8

Master data

Relative position detecting step

FIG. 237 (a) Revolution pulse

Time division signal
Signal position

FIG. 237 (b) signal
(Zone signal)

| Z_1 | Z_2 | Z_3 | Z_4 | Z_5 | Z_6 | Z_1 | Z_2 | Z_3 | Z_4 | Z_5 | Z_6 | Z_1 |

FIG. 237 (c) Address data

A^1 323a

A1 : Z1

A^2 323b

A2 : Z3

FIG. 238

Processing on Drive

Recording Reproducing System

In - Media Program

Physical Layout Table 532

Zone	Address
Z_1	A_8
Z_2	A_6
Z_3	A_4
Z_4	A_{10}

Calculation time : 1 sec

Cipher decoder

Public key

Secret Key decoding program

534

538b

Secret key signal
$\alpha \beta \gamma \cdot \cdot$ 512bit

$M = C^d \bmod$
$n, n=pq$

Disk check program 533a

OK 535 — Yes — Start

No 536 — Stop

Drive side

| Address Data | 38a |
| Disk revolution angle sensor | 335 |

Disk check program 533

Type 1

Optical ROM 2

65

Enciphered signal 538a
$\alpha \beta \gamma \cdot \cdot$ 512bit

Type 2 2a

67

Magnetic Record Unit

Processing in CD manufacturing plant

RSA disclosure secret key type

$C=E(M)=M^e \bmod n$

Cipher Encoder

Secret key

Secret key encoding program 537

Secret Key decoding Time : 10^9 years

Physical position table

Zone	Address
Z_1	A_8
Z_2	A_6
Z_3	A_4
Z_4	A_{10}

532

Processing in Plant

FIG. 239

Record Repro System

Disk Check CKT — 533

Physical Layout / shape Table — 532

Address	Zone
A_1	Z_1
A_2	Z_2
A_3	Z_3
A_4	Z_4
A_5	Z_5

A_n

Z_n

Collation Circuit — 535

Magnetic Repro CKT

Secret Key Decoder — 534

Optical Repro.CKT — 38

Address data — 38a

Address Position detection step — 335

A_n Address data

Z'_n Position data

Output/ Operation Stop Ping unit — 536

Display Unit — 16

8

2

6

17

FIG. 240

START — 471a

Is there secret key data for disk check in the optical record sector? — 471b

No

Is there secret key data for disk check in the magnetic record sector? — 471c

No

Yes

Secret ke data reproduced — 471d

Secret key decoding program started — 471e

Zone address table data An : Zn created — 471f

No

Is there disk check program in medium? — 471w

Yes

Disk check program started — 471g

n=0 — 471h

Disk check program

471l

n=n+1 — 471i

Disk address An searched — 471j

Zone No. Z'n corresponding to disk address An searched — 471k

Yes

Z'n=Zn ? — 471m

No

Yes

No

n=last? — 471n

Yes

No

Is there ROM disk check program ? — 471p

Yes

Check operation of ROM disk check program — 471q

No

Indication of "Illegal copy CD" — 471u

No

Disk software reproduction start — 471r

Yes — 471s

STOP or Reject

FIG. 241 (a)

Process by this invention

Molding	Aluminum evaporation	Protective layer	Printing 1 (1 sec.)	Printing 2 (1 sec.)		Printing 3 (1 sec.)

Ink 1 (Magnetic layer)

Ink 2 (Printing)

Magnetizing machine

ID No. and Copy Protect Signal → Encipher → (1 sec.)

540

2

ID No. Recording

Ink 3 (Protective layer or printing)

⇨ Completion

FIG. 241 (b)

Conventional process

Molding	Aluminum evaporation	Protective layer	Printing 1 (1 sec.)	Printing 2 (1 sec.)

Ink 1

Ink 2

⇨ Completion

FIG. 242 (a) Top View

FIG. 242 (b) Side View

FIG. 242 (c)

FIG. 242 (d)

FIG. 243

Record Reproduction Unit

Display

Output

ID No. — 550

549 — Reproducing unit

Separator

Separation key

Mixed signal

Secret key reproducer — 534

Disk shape data — 532

Collation program — 535

Judgement

Yes — Operation

No — STOP

Optical Reproduction unit

Disk shape data Extracting unit

Disk — 67

Secret key

Magnetic recording Track

538

Secret key

Optical ROM — 65

program

CD Production Unit — 529

Secret key generator — 537

Separation key — 548

Mixed signal

Mixer

Disk Physical shape table — 532

Address
Angle layout
Tracking
Pitch depth
Error rate

Unique ID No. generator — 546

FIG. 244 (a)

Longitudinal Velocity
(m/sec)

1/60 revolution

1.22
1.21
1.20

A_i

t

FIG. 244 (b)

Longitudinal Velocity
(m/sec)

5.9°

1.22
1.21
1.20

A_i

$V=V_0\pm0.01m/s$

t

FIG. 244 (c)

Longitudinal Velocity :
1.2m/s

2a

65a

S

539a

A_i

65 : Optical track

FIG. 244 (d)

Longitudinal Velocity :
1.2m/s→1.22m/s

2b

65b

θ

5.90°

S

539b

A_i

FIG. 245 (a)   FIG. 245 (b)   FIG. 245 (c)   FIG. 245 (d)

Legitimate master disk   Legitimate molded disk   Illegally copied master disk   Illegally copied molded disk

FIG. 246

FIG. 247

FIG. 248

Magnetic record sector

67

2

Secret
key
recording

C 3

Optical record sector

572

65z

The second original disk

575a

65z

C 1

C 2

C 4

580a

580b

580c

580d

572

FIG. 249

Record Repro Unit

Disk Check Program

Reference Physical Layout Chart — 532

Address	Angle	Tracking displace-ment	Pit depth
A_1	Z_1	T_1	D_1
A_2	Z_2	T_2	D_2
A_3	Z_3	T_3	D_3
A_4	Z_4	T_4	D_4
A_5	Z_5	T_5	D_5

533

Random extractor
Random number generator

582
583

A_n
Z_n
T_n
D_n

535 — Collation unit

Address data A'_n
Z'_n Angular position data
Tracking T'_n
D'_n
Pit depth
556
557

536 — Output/ Operation Stop measure

Display unit — 16

Clock

magnetic Repro CKT — 30
Secret key Table

Secret key decoder — 534
The primarin secret key decoder — 534a
monodirectional function operation unit — 534c
The second secret key decoder — 534b

Optical Repro CKT — 7
Secret key ducoding program
Secret key coded Table
Disk check program
Address detector — 557

Disk physical layout detection unit
Angle position detection unit
Time division circuit — 553a
Decontutraining correction unit — 553b
Decentering detection unit — 553c
Tracking amount detection unit — 554
Pit depth detection unit — 555
Amplitude detection unit — 555a
Many-value level slicer — 555a

553

8

24
Tracking control unit
Tracking amount sensor — 24a

6

2

17
17a — Revolution angle sensor

Multiple Protect signal area

FIG. 250 (a)   illegally copied disk

561a 561b 561c 561d 561e 561f

FIG. 250 (b)   Legitimate disk

560a 560b 560c 560d 560e 560f

$\lambda/4$ $\lambda/6$

FIG. 250 (c)   Detection voltage of optical reproduction signal and 2-level slicer

562c 562d 562e

S_1 S_2

S_1
S_0
0

FIG. 250 (d)   Digital Repro. signal (Detection slice level S_1)

1
0

FIG. 250 (e)   Envelope waveform

A_0 A_2 A_1

A
0

FIG. 250 (f)   Digital Repro. signal (Reference slice level S_0)

563c 563d 563e

1
0

FIG. 250 (g)   Multiple Protect signal $S_0 \times \overline{S_1}$

1
0

t t t t t

FIG. 251

Reference Physical Layout Table 532a

Address	Angle	Deviation m	Tolerance
A n	Z n	0	
		± 1	P n (1)
		± 2	P n (2)
		± 3	P n (3)
		$\pm m$	P n (m)

535
Collation unit → Check

Measured Disk Physical Layout Table 556a

Address	Angle	Deviation m	Quantity
A n	Z n	0	100
		± 1	8
		± 2	6
		± 3	3
		$\pm m$	

FIG. 252 (a)

No decentering

FIG. 252 (b)

Decentering
Example of decentering amount operation
by three points

Calculation example :

$$L'a = f(\theta a, \theta b, \theta c) = \frac{L}{2}\left(\tan\frac{\pi}{6} - \tan\left(\frac{\pi}{2} - \theta a\right)\right)$$

FIG. 253 (a)
Legitimate disk

FIG. 253 (b)
illegally copied disk

Reference Disk Physical Layout — 532

Address	Zone	Track displace-ment
A₁	Z₁	+1
A₂	Z₁	−1
· · ·	· · ·	· · ·

Measured disk Physical Layout Table — 556

Address	Zone	Track displace-ment
A₁	Z₁	0
A₂	Z₁	+1
· · ·	· · ·	· · ·

Collation

535 — Collation unit

Angle zone Z₁

An	Zn	Tn	Dn
A0	Z0	+1	π /6
A1	Z1	+1	π /4
A2	Z2	-1	π /6

532

Address 1   Address 2

FIG. 254 (a)
Address   A n

Reference address
A0   A1   A2

FIG. 254 (b)
Angle   Z n

Relative angle

0 deg

Z1   Z2

FIG. 254 (c)
Tracking displacement   T n

T0=+1   T1=+1   T2=-1

539a   539b   539c

FIG. 254 (d)
Pit depth   D n

D0=π /6   D1=π /6   D1=π /4   D2=π /6

FIG. 255(a)
Combination of
laser output

FIG. 255(b)
Laser output

FIG. 255(c)
Pit depth

FIG. 255(d)
Output
uncorrected

FIG. 255(e)
Output corrected
Slice Level So

FIG. 255(f)
Check signal
Slice Level S1

FIG. 255(g)
Copy Protect signal
for NG pit group

FIG. 255(h)
Copy Protect signal
for OK pit group

FIG. 256

Effect of Original Copy Protect given to Master disk production equipment
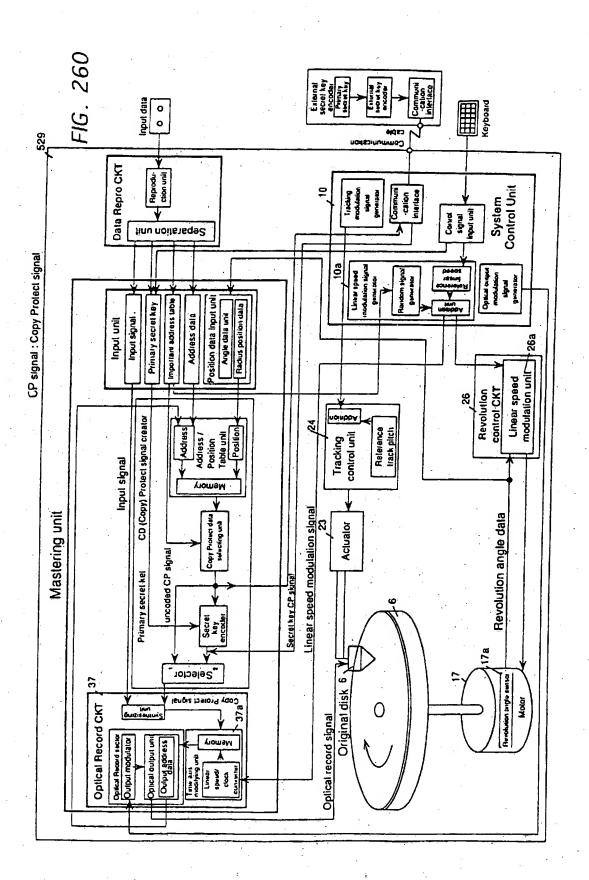
Master disk production equipment		A only (Angular direction)	B only (Tracking direction)	C only (Depth direction)	A+B (Angle×Address, Angle×Tracking)	B+C (Tracking×Address, Depth×Address)	A+C (Angle×Address, Angle×Depth)	A+B+C
Existing CD manufacturing equipment	Standard	○	○	○	○	○	○	○
	Minor remodeling	△	○	○	○	○	○	○
Existing MD/CD manufacturing equipment	Standard	○	△	○	○	○	○	○
	Minor remodeling	△	○	○	△	○	○	○
LD/CD manufacturing equipment	Standard	○	○	○	○	○	○	○
	Minor remodeling	△	○	○	○	○	○	○
LD/CD/MD manufacturing equipment	Standard	○	△	○	○	○	○	○
	Minor remodeling	△	○	○	△	○	○	○
Record Enabling type optical disk manufacturing equipment	Standard	△	△	△ Yield NG	△	△ Yield NG	△ Yield NG	△ Yield NG
	Minor remodeling	×	×	△ Yield NG	×	△ Yield NG	△ Yield NG	△ Yield NG

Copy Protect Method
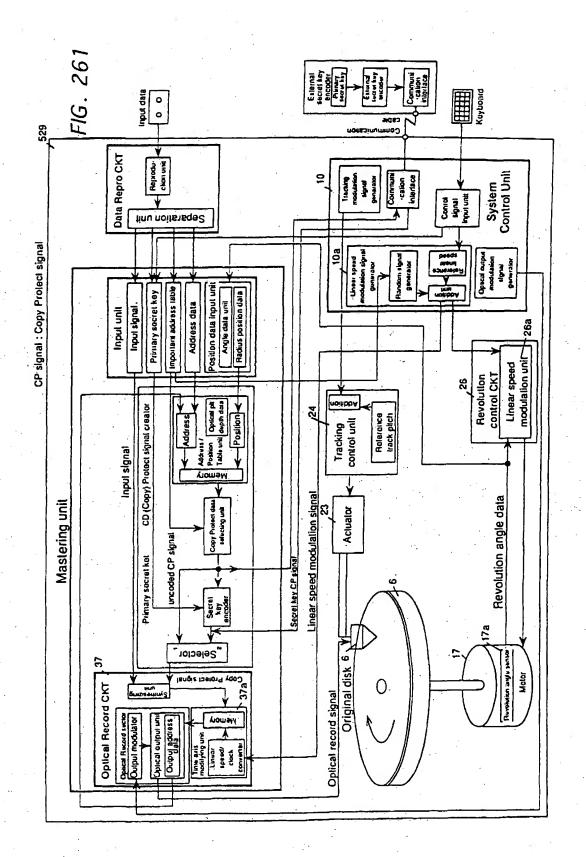
ROM Original Disk production equipment

FIG. 257

FIG. 258

FIG. 259

FIG. 260

FIG. 261

FIG. 262

Optical Disk manufacturer

Original disk
2

Cutting Machine

529

578

Data

Repro
Unit

Communication interface

Communication
cable

Uncoded Copy
Protect signal

Coded Copy
Protect signal

Software Copyright holder

External secret key
encoder

579

578a

secondary
communication interface

Primary secret key

32d

Laser output (pulse)

FIG. 263 (a)

Laser output (Amplitude modulation)

FIG. 263 (b)

FIG. 263 (c)

glass disk

573

572

574a   574b   574c   574d   574e

light sensitive material

FIG. 263 (d)

glass disk

560a   560b   560c   560d   560e

FIG. 263 (e)

Metallic Master disk

Molded disk

575

576

FIG. 264(a)

Original signal

562a

FIG. 264(b)

Record timing
signal after
correction

T

$T+\triangle T$

T

562b

FIG. 264(c)

Laser output

FIG. 264(d)

560a

T

560b

$T+\triangle T$

Pit shape

FIG. 264(e)

581a

FIG. 264(f)

Slice level
Reproduced waveform

581b

581c

FIG. 264(g)

Digital
reproduced signal
after correction

T

T

562c

FIG. 264(h)

Digital
reproduced signal
without correction

T

$T-\triangle T'$

562d

FIG. 265(a) Laser output (pulse)

FIG. 265(b) Laser output (Amplitude modulation)

FIG. 265(c) light sensitive material

G l a s s   d i s k

FIG. 265(d) G l a s s   d i s k

FIG. 265(e) Original disk plating process

Metallic original disk

G l a s s   d i s k

FIG. 265(f) Metall Master disk

Molded disk

FIG. 265(g) Measurement of reproduced signal—Extraction of OK pit group

Reflection film

Molded disk

FIG. 265(h) Production of the secondary original disk : Physical features of OK pit group
Addition of (angular position or/and, radius position or/and, address or/and, pit depth)

The secondary original disk 575a

FIG. 265(i) Link of the original disk and the secondary disk

Die for Master disk

The secondary Master disk   Metallic Master disk

575a   575

FIG. 265(j) Optical disk production

FIG . 266 (a)

Two-Master Disk
method

The secondary disk

65a

572a

Copy Protect
signal record

572

FIG . 266 (b)

The secondary disk

Joint

572

572a

Joint

The secondary disk

FIG. 267(a)

Laser output (pulse)

FIG. 267(b)

Laser output (Amplitude modulation)

FIG. 267(c)

Light sensored material

Light sensor

Glass disk

the secondary light sensor

FIG. 267(d)

Glass disk

the secondary light sensor

577

FIG. 267(e)

Pit monitor Extraction of OK pit group

OK pit group

Glass disk

the secondary light sensor

577

FIG. 267(f)

Recording in the secondary record sector of original disk :
Physical features of OK pit group .
Addition of (angular position or/and, radius position or/and, address or/and, pit depth).

Record

Glass disk

577

FIG. 267(g)

Original disk plating process

Metallic Master disk

575

Glass disk

577

FIG. 267(h)

Molding process

Metallic Master disk

Molded disk

FIG. 267(i)

Measurement of reproduced signal —Extraction of OK pit groups

Reflection film

Molded disk

576

575

FIG. 268(a)

One-Master
disk method

Copy Protect
signal record

65a

575

FIG. 268(b)

575

Molded optical disk

576

FIG. 269

'n' sets of pit groups are recorded in 'n' different recording conditions. ⟞584a

↓

Etching process : 'm' sets among 'n' sets of OK pit groups are produced with a certain yield. ⟞584b

↓

'm' sets of OK pit groups meeting the conditions are searched by reproducing the original disk with monitor beam. ⟞584c

↓

Production of physical layout table after measuring physical characteristics of OK pit groups. ⟞584d

↓

Physical layout coding ⟞584e

↓

Record in optical record sector? ⟞584f

No →

Yes ↓

Secret key recorded in the secondary light sensitive part 577 of the original disk or 572a of the secondary disk ⟞584g

↓

Disk board molding with the original disk ⟞584h

↓

Reflection film formed on molded disk ⟞584i

↓

Record on magnetic layer? ⟞584j

No →

Yes ↓

Production of magnetic record sector ⟞584k

↓

Secret key recorded in magnetic record sector ⟞584m

↓

Disk completion ⟞584n

FIG. 270

Application software program

```
            ┌─────────────┐
            │    Start    │ ─── 584a
            └─────────────┘
                  │
            ┌─────────────┐
            │  Routine b  │ ─── 584b
            └─────────────┘
                  │
          ╱───────────────╲  ─── 585a
         ╱ Disk Check Program╲         No
         ╲      OK?        ╱ ──────────────┐
          ╲───────────────╱               │
                  │ Yes                    │
            ┌─────────────┐ ─── 584c       │
            │  Routine 2  │                │
            └─────────────┘                │
                  │                        │
          ╱───────────────╲  ─── 585b      │
         ╱  Disk Check OK? ╲     No        │
         ╲                 ╱ ──────────────┤
          ╲───────────────╱               │
                  │ Yes                    │
     ┌───────────────────────┐ ─── 584d    │
     │ Program Install Routine│             │
     └───────────────────────┘             │
                  │                        │
          ╱───────────────╲  ─── 585c      │
         ╱ Disk Check Program╲    No        │
         ╲      OK?        ╱ ──────────────┤
          ╲───────────────╱               │
                  │ Yes                    │
            ┌─────────────┐ ─── 584e       │
            │Printing routine│             │
            └─────────────┘                │
                  │                        │
          ╱───────────────╲  ─── 585d      │
         ╱ Disk Check Program╲    No        │
         ╲      OK?        ╱ ──────────────┤
          ╲───────────────╱               ▼
                  │ Yes          584f   ┌─────────┐ ─── 584g
            ┌─────────────┐ ─────       │  STOP   │
            │Save Routine │             └─────────┘
            └─────────────┘
                  │
            ┌─────────────┐
            │ End Routine │
            └─────────────┘
                  │
            ┌─────────────┐
            │    STOP     │
            └─────────────┘
```

Fig. 271

Fig. 272

Fig. 273

Fig. 274

insert CD-ROM/RAM — *566a*

↓

Display ICON of CD-ROM / RAM — *566b*

↓

566c
Open Directory of first information? — No

↓ Yes

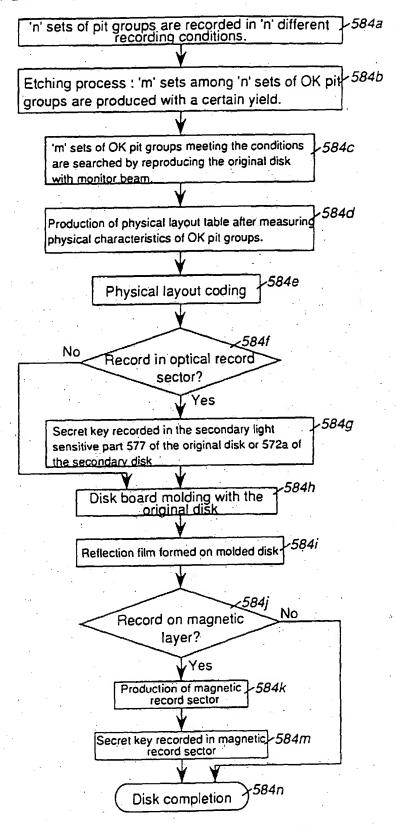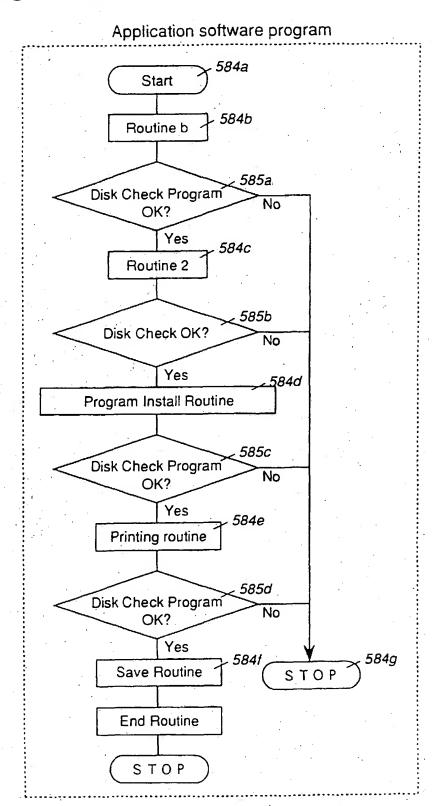Open Directory of first infoamation recorded in ROM portion of THe CD-ROM/RAM — *566d*

↓

566e
Open Directory of second information? — No

↓ Yes

Open Directory of second information recorded in RAM potion of the CD-ROM/RAM — *566f*

↓

566g
Display Virtual file sizes, physical file sizes, home machine name, home machine address, home Drive name, home Directory name

Capacity	Home machine name	Home Address	Drive Name	Directory
File X 120,000KB (0.05KB)	Henry, drl, JP	121,251,156,321	HDD-Y	CD-ROM VF "Z"
File σ 2				

↓

566h
Open Virtual File of second information? — No

↓ Yes

566i
Home machine ID=this machine ID? — No

↓ Yes

566p
Network is connected ? — No

Yes

Open physiccal file (or sub Directory) of home HDD (Drive Y, Directory Z) of home machine — *566j*

↓

Run — *566k*

Display "Network is not connected" — *566m*

↓

connect with Home machine through network. — *566n*

↓